AMENDMENT ACCOMPANYING RCE
Serial No. 10/774,298
Docket No. VEL03-GN003

In the Claims:

1. (CURRENTLY AMENDED) A chemical process system comprising:

~~a first chemical reactor comprising microchannels adapted to be in fluid communication with an inlet stream and an outlet stream for carrying out a continuous process;~~

~~a pressure vessel at least partially containing the first chemical reactor therein, the pressure vessel concurrently adapted to be occupied by an inert medium to compress the microchannels of the first chemical reactor; and~~

~~a purge stream adapted to be in fluid communication with an inert medium source for selectively conveying the inert medium from the inert medium source and into fluid communication with the first chemical reactor;~~

~~a heat exchanger, housed at least partially within the pressure vessel, in fluid communication with the first chemical reactor;~~

~~where the microchannels are isolated from an interior of the pressure vessel.~~

a pressure vessel including a wall;

a first microchannel module mounted within the pressure vessel and including at least two sets of isolated microchannels;

a steam conduit extending through the pressure vessel wall and into communication with a first set of isolated microchannels of the first microchannel module;

a hydrocarbon conduit extending through the pressure vessel wall and into communication with the first set of isolated microchannels of the first microchannel module;

a fuel conduit extending through the pressure vessel wall and into communication with a second set of isolated microchannels of the first microchannel module;

an oxygen source conduit extending through the pressure vessel wall and into communication with the second set of isolated microchannels of the first microchannel module;

a product conduit in communication with the first set of isolated microchannels and extending through the pressure vessel wall for conveying products from the first set of isolated microchannels;

an exhaust conduit in communication with the second set of isolated microchannels and extending through the pressure vessel wall for conveying exhaust from the second set of isolated microchannels;

wherein the first set of isolated microchannels is in thermal communication with the second set of isolated microchannels; and

wherein the first set of isolated microchannels houses a steam reformation catalyst.

2-6. (CANCELLED)

7. (CURRENTLY AMENDED) The chemical process system of claim 1, wherein the first ~~chemical reactor~~ microchannel module is at least one of cooled and heated at least in part by ~~the inert~~ a compressive medium present within the pressure vessel and around the first microchannel module.

8. (CURRENTLY AMENDED) The chemical process system of claim ~~1~~ 7, wherein the ~~inert~~ compressive medium includes at least one of helium, neon, argon, krypton, xenon, and nitrogen.

9. (CURRENTLY AMENDED) The chemical process system of claim ~~1~~ 7, wherein the ~~inert~~ compressive medium includes water.

10. (CANCELLED)

11. (CURRENTLY AMENDED) The chemical process system of claim ~~10~~ 1, wherein the catalyst comprises at least one of a catalytic lining, a catalytic pellet, and a catalytic insert.

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12. (CURRENTLY AMENDED) The chemical process system of claim ~~1~~ 7, wherein the ~~inert~~ compressive medium within the pressure vessel is adapted to be in fluid communication with at least one of a pump and a compressor.

13. (CURRENTLY AMENDED) The chemical process system of claim ~~1~~ 7, further comprising a controller operatively coupled to a first sensor monitoring an internal pressure within the pressure vessel and a second sensor monitoring an internal pressure within the first ~~chemical reactor~~ set of isolated microchannels, wherein the controller is responsive to data generated by the first sensor and the second sensor to operate the pressure vessel at a higher pressure than the first ~~chemical reactor~~ set of isolated microchannels.

14. (CURRENTLY AMENDED) The chemical process system of claim 13, wherein the controller is operatively coupled to a vent valve in fluid communication with the pressure vessel to selectively vent at least a portion of the ~~inert~~ compressive medium within the pressure vessel to decrease the internal pressure within the pressure vessel.

15. (CURRENTLY AMENDED) The chemical process system of claim 13, wherein the controller is operative to detect a leak within the first ~~chemical reactor~~ set of isolated microchannels from the data generated by at least one of the first sensor and the second sensor.

16. (CANCELLED)

17. (CURRENTLY AMENDED) A chemical process system comprising:

~~a first unit operation including microchannels adapted to be in fluid communication an inlet stream, and an outlet stream;~~

~~a second unit operation in thermal communication with the first unit operation; and~~

~~a pressure vessel at least partially containing the first unit operation therein and adapted to be concurrently occupied by a compressive medium adapted to maintain the first unit operation in compression;~~

~~where the microchannels are isolated from an interior of the pressure vessel~~

a pressure vessel having an interior;

a steam conduit extending into the interior of the pressure vessel;

a hydrocarbon conduit extending into the interior of the pressure vessel;

a fuel conduit extending into the interior of the pressure vessel;

an oxygen source conduit extending into the interior of the pressure vessel;

a product conduit extending into the interior of the pressure vessel;

an exhaust conduit extending into the interior of the pressure vessel;

a first microchannel module including

a first set of microchannels fluidically isolated from the interior of the pressure vessel and in communication with the steam conduit via a steam manifold, the hydrocarbon conduit via a hydrocarbon manifold, and the product conduit via a product manifold, the first set of microchannels including a first steam reformation catalyst; and

a second set of microchannels fluidically isolated from the interior of the pressure vessel and in communication with the fuel conduit via a fluid manifold, the oxygen source conduit via an oxygen source manifold, and the exhaust conduit via an exhaust manifold, the second set of microchannels being in thermal communication with the first set of microchannels; and

a second microchannel module fluidically arranged in parallel with the first microchannel module and including

a third set of microchannels fluidically isolated from the interior of the pressure vessel and in communication with the steam conduit via the steam manifold, the hydrocarbon conduit via the hydrocarbon manifold, and the product conduit via the product manifold, the third set of microchannels including a second steam reformation catalyst; and

a fourth set of microchannels fluidically isolated from the interior of the pressure vessel and in communication with the fuel conduit via the fuel manifold,

the oxygen source conduit via the oxygen source manifold, and the exhaust conduit via the exhaust manifold, the fourth set of microchannels being in thermal communication with the third set of microchannels.

18. (CURRENTLY AMENDED) The chemical process system of claim 17, wherein the second ~~unit operation~~ set of microchannels includes ~~at least one of~~ a heat exchanger ~~and a chemical reactor~~.

19. (CANCELLED)

20. (CURRENTLY AMENDED) The chemical process system of claim ~~19~~ 18, wherein the ~~second unit operation also includes a~~ heat exchanger ~~facilitating~~ facilitates thermal energy transfer between the second ~~unit operation~~ set of microchannels and the first ~~unit operation~~ set of microchannels.

21. (CANCELLED)

22. (CURRENTLY AMENDED) The chemical process system of claim 17, further comprising a purge stream adapted to be in fluid communication with ~~the~~ a compressive medium within the pressure vessel and in selective fluid communication with the first ~~unit operation~~ set of microchannels and the third set of microchannels.

23-25. (CANCELLED)

26. (CURRENTLY AMENDED) The chemical process system of claim ~~25~~ 17, wherein:

~~the first unit operation includes a chemical reactor;~~

~~the first unit operation includes a catalyst in series with the microchannels thereof;~~ ~~and~~

the first catalyst and the second catalyst ~~comprises~~ include at least one of a catalytic lining, a catalytic pellet, and a catalytic insert.

27-28. (CANCELLED)

29. (CURRENTLY AMENDED) The chemical process system of claim ~~25~~ 17, wherein:

at least one of the microchannels of the first ~~unit operation~~ set of microchannels or the ~~and the microchannels of the~~ second ~~unit operation~~ set of microchannels include a catalyst in series therewith; and

the microchannels at least one of upstream of the catalyst and downstream from the catalyst comprise a heat exchanger.

30. (CANCELLED)

31. (CURRENTLY AMENDED) The chemical process system of claim ~~30~~ 17, wherein ~~the microchannels of~~ the first ~~unit operation~~ set of microchannels ~~are adapted to carry a first fluid in a first direction~~ and ~~the microchannels of~~ the second ~~unit operation~~ set of microchannels are ~~adapted to carry a second fluid in a second direction, opposite the first direction~~ configured in a counter-flow arrangement.

32. (CURRENTLY AMENDED) The chemical process system of claim ~~25~~ 17, further comprising a controller to regulate an internal pressure within the pressure vessel.

33. (CURRENTLY AMENDED) The chemical process system of claim 17, wherein the pressure vessel includes a recycle stream for cycling ~~the~~ a compressive medium into and out of the pressure vessel.

34-47. (CANCELLED)

48. (CURRENTLY AMENDED) The chemical process system of claim 1, wherein:

a controller operatively coupled to at least a first system sensor detecting an internal pressure within the first ~~chemical reactor~~ set of isolated microchannels and a second system sensor detecting an internal pressure within the pressure vessel, the

controller being responsive to data generated by the first system sensor and the second system sensor to adjust the internal pressure within the pressure vessel.

49-52. (CANCELLED)

53. (CURRENTLY AMENDED) The chemical process system of claim 48, wherein

the controller is operatively coupled to a control valve in fluid communication with ~~the inert~~ a compressive medium source and upstream from the pressure vessel to selectively provide the ~~inert~~ compressive medium to the vessel and increase the internal pressure therein in response to data received from the first sensor and the second sensor; and

the pressure vessel includes an outlet stream including a vent valve in series therewith to vent excess pressurized ~~inert~~ compressive medium from the pressure vessel.

54. (CURRENTLY AMENDED) The chemical process system of claim 1, wherein the pressure vessel includes a purge valve in series therewith, operatively coupled to the controller, and in selective fluid communication with the first ~~chemical reactor~~ set of isolated microchannels.

55-56. (CANCELLED)

57. (PREVIOUSLY PRESENTED) The chemical process system of claim 1, wherein:

the pressure vessel includes a recycle stream; and

the recycle stream is in series with at least one of a compressor, a pump, a condenser, and an external heat exchanger.

58. (CURRENTLY AMENDED) The chemical process system of claim 1, wherein the pressure vessel includes at least one refurbishment line to refurbish a the catalyst in ~~series with~~ the first ~~chemical reactor~~ set of isolated microchannels.

59-60. (CANCELLED)

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61. (CURRENTLY AMENDED) The chemical process system of claim 1, wherein:

at least one microchannel of the first ~~chemical reactor~~ set of isolated microchannels is adjacent to at least one microchannel of the ~~heat exchanger~~ second set of isolated microchannels and is in thermal communication therewith;

the first ~~chemical reactor~~ set of isolated microchannels includes at least one of a mixer, a chemical separation unit, and an integral heat exchanger.

62. (CURRENTLY AMENDED) The chemical process system of claim 61, wherein:

the first ~~chemical reactor~~ catalyst includes at least one of a catalytic lining, a catalytic pellet, and a catalytic insert.

63. (CANCELLED)

64. (CURRENTLY AMENDED) The chemical process system of claim 1, wherein:

the pressure vessel is generally cylindrical in shape; and

the first ~~chemical reactor~~ microchannel module is generally rectangular in cross-section.

65. (CANCELLED)

66. (CURRENTLY AMENDED) The chemical process system of claim ~~60~~ 1, wherein:

~~the first chemical reactor is adapted to receive a first reactant feed via the inlet stream;~~

~~the heat exchanger includes a second chemical reactor adapted to receive a second reactant feed via the second inlet stream;~~

~~the first chemical reactor and the second chemical reactor are adapted to be maintained in compression by the inert medium within the pressure vessel; and~~

~~at least one of the first chemical reactor and the second chemical reactor~~ the first microchannel module comprises a plurality of laminated sheets.

67. (CANCELLED)

68. (CURRENTLY AMENDED) The chemical process system of claim ~~67~~ 1, wherein the pressure vessel includes a compressive medium ~~includes~~ including water and the pressure vessel is an elevated temperature water source.

69. (CURRENTLY AMENDED) The chemical process system of claim ~~67~~ 1, wherein the pressure vessel includes a compressive medium and the compressive medium includes an inert medium.

70. (CURRENTLY AMENDED) The chemical process system of claim ~~67~~ 1, wherein the first ~~chemical reactor~~ set of isolated microchannels accommodates a throughput of between 100 liters per hour to approximately 10,000 liters per hour.

71. (CURRENTLY AMENDED) The chemical process system of claim ~~67~~ 1, further comprising a vent valve in fluid communication with the pressure vessel.

72. (CURRENTLY AMENDED) The chemical process system of claim ~~67~~ 1, further comprising a controller operatively coupled to sensors associated with the pressure vessel and the first chemical reactor, wherein the controller is operative to maintain an internal pressure within the pressure vessel to be greater than an internal pressure within the first ~~chemical reactor~~ set of microchannels.

73. (CURRENTLY AMENDED) The chemical process system of claim ~~67~~ 1, further comprising a purge stream providing selective fluid communication between an interior of the pressure vessel and an interior of the first ~~chemical reactor~~ set of isolated microchannels.

74. (CURRENTLY AMENDED) The chemical process system of claim ~~67~~ 1, further comprising a recycle stream for cycling ~~the~~ a compressive medium into and out of the

pressure vessel, wherein a heat exchanger is in thermal communication with the recycle stream.

75-96. (CANCELLED)

97. (NEW) The chemical process system of claim 1, wherein the steam conduit and the hydrocarbon conduit are a combined conduit.

98. (NEW) The chemical process system of claim 1, wherein the steam conduit and the hydrocarbon conduit are separate conduits.

99. (NEW) The chemical process system of claim 1, wherein the oxygen source conduit is adapted to supply air to the second set of isolated microchannels.

100. (NEW) The chemical process system of claim 17, wherein the steam conduit and the hydrocarbon conduit are a combined conduit and the steam manifold and the hydrocarbon manifold are a combined manifold.

101. (NEW) The chemical process system of claim 17, wherein the steam conduit and the hydrocarbon conduit are separate conduits; and wherein the steam manifold and the hydrocarbon manifold are separate manifolds.

102. (NEW) The chemical process system of claim 17, wherein the oxygen source conduit and oxygen source manifold are adapted to supply air to the second set of microchannels and the fourth set of microchannels.

103. (NEW) The chemical process system of claim 1, wherein the first set of isolated microchannels and the second set of isolated microchannels include an arrangement of repeating units.

104. (NEW) The chemical process system of claim 103, wherein one of the repeating units includes

a reactant microchannel and a product microchannel of the first set of isolated microchannels, and

a fuel microchannel, an oxygen source microchannel, and a product microchannel of the second set of isolated microchannels; and

wherein the reactant microchannel of the first set of isolated microchannels is adjacent the fuel microchannel of the second set of isolated microchannels.

105. (NEW) The chemical process system of claim 104, wherein the oxygen source microchannel interposes the fuel microchannel and the product microchannel of the second set of isolated microchannels.

106. (NEW) The chemical process system of claim 105, wherein the repeating unit includes

two reactant microchannels of the first set of isolated microchannels interposed by the product microchannel of the first set of isolated microchannels,

two oxygen source microchannels of the second set of isolated microchannels interposed by the product microchannel of the second set of isolated microchannels, and

two fuel microchannels of the second set of isolated microchannels interposed by the two oxygen source microchannels of the second set of isolated microchannels and the product microchannel of the second set of isolated microchannels.

107. (NEW) The chemical process system of claim 17, wherein the first set of microchannels and the second set of microchannels include an arrangement of repeating units.

108. (NEW) The chemical process system of claim 107, wherein one of the repeating units includes

a reactant microchannel and a product microchannel of the first set of microchannels, and

a fuel microchannel, an oxygen source microchannel, and a product microchannel of the second set of microchannels; and

wherein the reactant microchannel of the first set of microchannels is adjacent the fuel microchannel of the second set of microchannels.

109. (NEW) The chemical process system of claim 108, wherein the oxygen source microchannel interposes the fuel microchannel and the product microchannel of the second set of microchannels.

110. (NEW) The chemical process system of claim 109, wherein the repeating unit includes

two reactant microchannels of the first set of microchannels interposed by the product microchannel of the first set of microchannels,

two oxygen source microchannels of the second set of microchannels interposed by the product microchannel of the second set of microchannels, and

two fuel microchannels of the second set of microchannels interposed by the two oxygen source microchannels of the second set of microchannels and the product microchannel of the second set of microchannels.